

A REVIEW OF THE GENUS GITHOPSIS¹

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(Plate 555)²

GITHOPSIS, an endemic genus of annual campanulaceous herbs of Pacific North America, illustrates a method in the mechanics of the origin of species, namely, the fragmentation through recent geologic time of a once wide-ranging species, which may be taken as the ancestral prototype and which occupied much of the present range of the genus, into geographically discontinuous units now recognizable as species. These derivative species, then, have ultimately occupied contiguous but physiographically discrete regions.

In the field *Githopsis* species are subordinate elements in the biota, appearing in the spring months as delicate annuals growing beneath shrubs or subshrubs. They complete their life cycles in about two months and are easily overlooked in the field. It is not surprising that no synoptical study of the genus has been made during the near century that it has been known to botanists.

Githopsis as a genus was published by Nuttall in the year 1843.³ He described at that time *Githopsis specularioides* which, accordingly, becomes the indubitable type-species of the genus. The generic name *Githopsis* was suggested to Nuttall by the long leafy calyx-lobes which recall those of the European Corn Cockle, *Agrostemma Githago*.⁴ The affinity of the newly proposed genus to the campanulaceous genus *Specularia* was pointed out by Nuttall and is reflected in his choice of specific name "specularioides."

This study has been importantly advanced by generous assistance from Sir A. W. Hill, Kew, who loaned critical material, and by Mr. George Taylor, British Museum of Natural History, South Kensington, who furnished notes upon the type of *Githopsis specularioides* against selected collections sent him for comparison. In this country it is a pleasure to extend my thanks especially to Dr. W. L. Jepson who kindly made notes and comparisons for me at Kew in 1935 and

¹ Presented in abridged form at November, 1937, meeting of the Colorado-Wyoming Academy of Sciences, at Boulder, Colo.

² Cost of the plate defrayed by the University of Colorado.

³ Trans. Amer. Philos. Soc. n. s. 8: 258. 1843.

⁴ Corn Cockle, which in turn seems to have received its name from another plant, is characterized by Darlington (Fl. Cestricea ed. 3, 31. 1853) thus: "This foreign weed (specifically named *Githago*, from its fancied resemblance to "Gith," or Guinea-Pepper), though diligently rooted out by all neat farmers, obstinately maintains its ground in our grain fields."



Isotype of GITHOPSIS PULCHELLA

who made available the photograph accompanying this paper. I am grateful to Dr. W. R. Maxon, Dr. F. W. Pennell and to Mr. C. A. Weatherby for important notes and to the curators of the following herbaria for courtesies relative to my study of their collections: California Academy of Sciences, Stanford University, University of California, Pomona College, Jepson Herbarium at Berkeley, the herbaria of Dr. Robert F. Hoover, Berkeley, and of Mr. F. W. Peirson of Altadena, California, United States National Herbarium and the Rocky Mountain Herbarium.

GITHOPSIS Nutt.—Inconspicuous annuals, usually of low often simple habit, the stems commonly angled, sometimes freely branched from near the base and then of tufted globular habit; herbage glabrous or commonly hispid-pubescent with stiff short hairs; leaves inconspicuous, scattered, the internodes evident, the leaf-blades cuneate-obovate, narrowed to the sessile base, entire or nearly so or evidently toothed at the summit and also with a few lateral teeth; flowers axillary, borne in the upper stem-axils or only terminal or both; calyx-tube medianly distended, lineate to ribbed or even deeply grooved, the lobes usually conspicuous, often equalling the tube, leaf-like (indeed often toothed in the manner of the leaves), linear-acicular or subulate to narrowly lanceolate, firm, erect to widely spreading and sickle-curving at post-anthesis; corolla minute, little if at all exerted, to larger and showy, then *Linanthus*-like, salverform to campanulate, one-half to one and one-half times as long as the calyx-lobes; seeds ovoid to elliptical or subtriquetrous, 0.5–1.0 mm. long, smooth, shining and concolorous.

Type species, *Githopsis specularioides* Nutt.

KEY TO THE SPECIES

- Stems stout to slender but never elongated-filiform, the branches many to few; flowers evident (more than 4 mm. long); calyx-tube 4–12 mm. long.
- Middle cauline leaves oblong-ovate, conspicuous, recalling those of *Euphorbia Peplus*; corolla-lobes obtuse at the apex. 1. *G. latifolia*.
- Middle cauline leaves linear or short-oblong, reduced, mostly inconspicuous; corolla-lobes rounded or acute at apex.
- Corolla 15–20 mm. long (i. e. half again as long as the calyx-lobes), showy; plants slender, glabrate above, openly and sparingly branched. 2. *G. pulchella*.
- Corolla 4–10 (or 15) mm. long, inconspicuous (somewhat showy in large-flowered race of *G. calycina*); plants mostly stout (slender in *G. diffusa*), setulose to glabrate, freely, often abundantly branched.
- Corolla 5–10 mm. long; fruiting calyx distended medianly, more or less strongly ribbed.
- Corolla one-half to about equalling the calyx-lobes at anthesis, bright blue; calyx-lobes at post-anthesis erect or turbinate-spreading, linear-subulate, never outwardly sickle-curving. 3. *G. specularioides*.

- Corolla equalling (or in a large-flowered race conspicuously exceeding) the calyx-lobes at anthesis, dark blue; calyx-lobes at post-anthesis strongly accrescent, foliaceous, lance-subulate, widely or even arcuately flaring.....4. *G. calycina*.
- Corolla 3-5 mm. long; fruiting calyx linear, a little enlarged at the summit, 5-nerved, not at all ribbed.
Fruiting calyx 8-11 mm. long; herbage usually wholly glabrous; stems openly and sparingly branched, the plants thus tall (10-30 cm. high) and slender.....5. *G. diffusa*.
- Fruiting calyx 4-7 mm. long; herbage distinctly setulose; stems shortly and repeatedly branched, the plants thus as broad as high (5-12 cm. high), tufted and leafy.....6. *G. gilioides*.
- Stems elongated-filiform, the branches few, widely spreading, almost twining; flowers minute (3-6 mm. long); calyx-tube 3-5 mm. long.....7. *G. filicaulis*.

TREATMENT OF THE SPECIES

1. *GITHOPSIS LATIFOLIA* Eastw. Proc. Calif. Acad. Sci. ser. 4, 20: 154. 1931, based on a coll. of (Mrs.) *A. L. Coombs*, IX 1912, made at Big Meadows, Plumas Co., Calif. Type (Calif. Acad. Sci. Herb. 171875) examined. Only upper portion of plant extant.—Stems slender, elongated, somewhat straggling, giving a loose habit; herbage almost wholly glabrous, with some few hairs along the stem-angles; middle cauline leaves oblong-obovate, sessile, scattered, entire, 12-20 mm. long, the basal leaves unknown; flowers wholly terminal; calyx-lobes about equalling or slightly exceeding the corolla, narrowly lanceolate, thin, widely spreading; corolla open-campanulate, light purple, "1 cm. across," the lobes distinctly obtuse at the apex (very broad for the genus); young capsule lightly ribbed, the bases of the calyx-lobes scabrous; seed unknown.

With the type specimen but a slender starveling of a plant, *Githopsis latifolia* is the least known member of the genus. Of this species I have seen only the type collection. Its anomalous characters of leaf and corolla lead one to doubt the propriety of maintaining it here. Yet, coming as it does from the least known area of the Sierra Nevada of California where little botanizing has been carried on since the days of the resident collectors, Mrs. Mary E. Pulsifer Ames, Mrs. Rebecca Merritt Austin¹ and John Gill Lemmon,² it seems worth while

¹ Mrs. R. M. Austin (1832-1919), as an active collector of the native flora between the years 1866 and 1900, botanized particularly in Modoc, Butte and Plumas counties. In addition to sending her collections to E. L. Greene, especially while he was Professor of Botany at the University of California (1885-1895), Mrs. Austin made considerable distributions of her collections. Accordingly her collections are to be found in the Brandegee Herb. at Berkeley, in the Jones Herb. at Pomona Coll. and in the U. S. Nat. Herb. Her biography has been done by Jepson, *Madroño* 2: 130-133, 157. 1934.

² John Gill Lemmon (1832-1908) was first a resident of Sierra Valley, Plumas County, upon his coming to California. He botanized at several localities about the

to point out its characters rather prominently that we may search for the plant over that area toward the day when we may better evaluate its validity as a species.

2. *G. PULCHELLA* Vatke, *Linnaea* **38**: 714. 1874, based on *Bridges 153* from "California," the exact locality unknown. Bridges' notebooks are not extant (cf. biographical sketches by Stearns, *West Amer. Sci.* **3**: 223–227. 1887; Johnston, *Contr. Gray Herb.* **81**: 98–106. 1928; Jepson, *Madroño* **2**: 84–88. 1933). Isotype (in Herb. Hookerianum, Kew, England) studied. *Bridges 146*, distributed by Smiths. Inst., apparently not taken along with the type number, *Bridges 153*, since the former collection is distinctly hairy and represents a hirsutulous race. *Githopsis specularioides* var. *glabra* Jepson, *Man. Fl. Pls. Calif.* 974. 1925, based on *Geo. Hansen 494*, from Antelope, Amador Co., Calif. Isotypes studied.—Stems slender, divergent, striate, with a few long branches from the base, these openly or even laxly branching again, 8–20 cm. high; herbage glabrous or nearly so (somewhat setulose under binocular), hispidulose or setulose along the stem-angles, especially below; upper cauline leaves linear-oblong, serrulate, obtuse at the base, firmly rim-margined, the lower leaves all withered at anthesis; calyx-lobes linear, acicular and Phlox-like or subulate, 8–15 mm. long, shortly acute, the midnerve raised, in post-anthesis the calyx-lobes in addition impressed-lineate, sometimes with a few bristle-like hairs about the sinuses of the lobes; corolla half again as long as the calyx, campanulate, deep blue, 15–17 (or 20) mm. long, the lobes shortly acute, apiculate, venose; capsule-tube broadest just above the middle, constricted at the summit, firmly to even deeply ribbed, essentially glabrous or retrorse-pubescent in age or in a hairy race; seed oblong or oval, bilaterally flattened, brown-shining, 0.8–1.0 mm. long.—Representative colls. CALIFORNIA. Amador Co.: Drytown, 500 ft., *Hansen 497*; [foothills], VI 1889, *E. L. Greene*. Calaveras Co.: Gwin Mine, 1100 ft., *Jepson 1783*; Angels Camp, 1200 ft., *J. P. Tracy 5688*; Vallecito, 1748 ft., 12 VI 1915, *A. L. Grant*. Tuolumne Co.: Chinese Camp, 30 V 1915, *A. L. Grant*. Stanislaus Co.: "California," 1854, *J. M. Bigelow*;¹ Waterford, *R. F. Hoover 1095*; Italian Bar, "wooded country," ca. 1600 ft., *Jepson 6372*. Mariposa Co.: Mt. Bullion, *Bolander 4853*.

An endemic species of the central Sierra Nevada foothills and middle elevations, *Githopsis pulchella* has a very restricted range, extending less than seventy miles in a north-south direction. This fact assists in the fixing of the probable origin of Bridges' type col-

county during his residence there, as for instance in Mohawk Valley, in the vicinity of Culvers Ranch, on May 28, 1889. His herbarium is now at Berkeley. His biography has been written by Jepson, *Dict. Am. Biog.* **11**: 162–163. 1933.

¹ Perhaps from vicinity of Knights Ferry, Stanislaus River. Cf. *Pac. R. R. Rept.* **4**: 116. 1857, where listed as *G. specularioides*.

lection. It is known that he visited the mining town of Silver Mt. and that he passed through the already famous Calaveras Grove of Big Trees en route (cf. Madroño 2: 85). Another English collector, William Lobb, visited the Calaveras Grove of Big Trees in 1853, having heard certain preliminary reports of trees of incredible size at a meeting of the California Academy of Natural Sciences¹ early in the same year.² It was by Lobb's communication of cones and material that the English horticultural world was informed of the existence of these vegetable giants. This activity of Lobb doubtless interested Thomas Bridges in visiting the region for possible novelties prized by the horticulture of that day. The reference of Bridges to "Mariposa mountains" (Trans. Bot. Soc. Edinburgh 8: 434-435. 1866) may involve this visit of 1857, the date recorded on the isotype of *Githopsis pulchella* at Kew, and may have included the known visit to the Calaveras Grove. In any case Bridges' material represents *Githopsis pulchella* in its typical phase as it occurs commonly in the foothill country of Calaveras and Mariposa counties.

Very few illustrations of *Githopsis* species are found in botanical literature. It is interesting that the first published drawing of any species of *Githopsis* is a good likeness of *Githopsis pulchella*, although it purported to be *G. specularioides*. This appeared with a note by N. E. Brown in the Gardeners' Chronicle (ser. 3, 16: 244. 1894, as fig. 34) and was "of a plant in the Royal Gardens, Kew," the source of the cultivated subject not indicated. Upon examination of the preserved material, the basis of the illustration, the corollas, which were illustrated as of remarkable size and wholly unknown for *Githopsis specularioides*, show the plant to be *Githopsis pulchella*. Sir A. W. Hill writes that the source of the seed from which the plant was grown at Kew is unrecorded. Since *Githopsis pulchella*, surely an attractive annual, inhabits the very Mother Lode country, may the seed not have been sent to Kew by some appreciative gold-seeker far from his beloved England upon a stroll away from his diggings?

There is apparently a hirsutulose race of this species. Indeed, both glabrous and hirsutulose plants appear in the same colony as attested by such collections as *Tracy 5688* and *Grant* from Vallecito. The corolla-parts may vary away from the pentamerous condition to from 6 to 7 (*Jepson 6311* from Chinese Camp, Tuolumne Co.). The

¹ The name carried by the Academy at its inception.

² See H. G. Bloomer in Proc. Calif. Acad. Sci. 3: 399-400. 1868.

corolla-color may vary from the usual deep blue to a light purple with a white throat. Nevertheless, the flower-size is distinctive for the genus, no other species having the showy if not handsome open corollas of *Githopsis pulchella*.

3. *G. SPECULARIOIDES* Nutt. Trans. Amer. Philos. Soc. n. ser. 8: 258. 1843, based on a coll. by *Nuttall* from the "plains of the Oregon, near the outlet of the Wahlamet." We know that Nuttall made his headquarters during 1835 on Sauvie Island, then called Wappatoo Island, at the mouth of the Willamette River. Accordingly it seems likely that the type specimen was taken there. Type (in Brit. Mus. Nat. Hist., South Kensington) studied for me by Mr. George Taylor and compared with submitted collections from the region. Fragments of what is apparently the type coll. at Acad. Nat. Sci., Philadelphia.—Stems stout or firm, usually short and simple or a little branched from the base, angled below, terete above, 5–12 (or 18) cm. high; herbage gray-hispidulose; middle and upper cauline leaves inconspicuous, scattered, appressed to the stem, the blades cuneate-obovate, narrowed to the sessile base, 3-toothed at the summit and often with a pair or more of lateral serratures, 4–14 mm. long, the lowermost cauline leaves with shorter blades, more orbicular or ovate, early withering; flowers borne in upper stem-axils and terminal; calyx-lobes one-half to about equalling the corolla at anthesis, impressed-lineate and with a strong midnerve, linear-subulate, shortly acute or blunt, often toothed, firm and somewhat thickened, 6–10 mm. long, lengthening at post-anthesis, then 8–14 mm. long, permanently erect to somewhat flaring but never outwardly strongly sickle-curving; corolla salverform, less often campanulate, 4–7 mm. long, bright usually "deep" blue, the lobes acute; capsule striately ribbed, often deeply so, especially at maturity; seed ovoid, 0.5–0.8 mm. long, imperfectly triquetrous or compressed, smooth, shining, light brown. Representative colls. WASHINGTON. Whitman Co.: Wawawai, V 1898, *Elmer 1015*; Columbia Co.(?): foothills of Blue Mts., 15 V 1897, *R. M. Horner 323*; Klickitat Co.: Columbia R., VI 1883, *Suksdorf*. OREGON: Marion Co.: Silverton, 1871, *E. Hall 334*; Douglas Co.: along So. Umpqua, near Riddle, 5 VI 1930, *Henderson 12,989*; Crook Co.: Grizzly Butte, 13 VI 1894, *Leiberg 220*. CALIFORNIA: Humboldt Co.: Alder Pt. on Eel R., 500 ft., *Tracy 1906*; Kneeland Prairie, 2500 ft., *Tracy 2655*; Jarnigans, VII 1888, *Chesnut & Drew*; Mendocino Co.: Sherwood Valley, *Davy & Blasdale 5214*; Handleys, V 1903, *J. MacMurphy 23*; Eel R., 6 VI 1893, *Blankinship*; Sonoma Co.: fields east of Santa Rosa, *Heller & Brown 5308*; Napa Co.: Mt. St. Helena, 30 VIII 1888, *E. L. Greene*; Wooden Valley Grade, w. side of Napa Range, "on recent burn," *Keck 1022*; Santa Clara Co.: without further loc., *M. E. P. Ames* (ex Canby Herb.); "California," without further loc. but perhaps from this co., 1868–9, *Kellogg & Harford 618*; foothills w. of Los Gatos, *Heller 7339*; Monterey Co.: Tassajara Hot

Sprs., *Elmer 3140*; Santa Barbara Co.: Painted Cave Rch., *Eastwood 87* (uncertain coll.—to be looked for in Santa Ynez Mts.); Santa Cruz Isl., “steep open slope,” 21 IV 1932, *Hoffmann* (small pls., 2–4 cm. high!); Siskiyou Co.: Yreka, 1876, *E. L. Greene*; Plumas Co.: Hospital Hill near Quincy, IV 1897, *Austin 1004*; Amador Co.: Lancha Plana, 400 ft., *Hansen 1271* (very dwarf); Tuolumne Co.: Grant Rch. near Columbia, 21 V 1915, *A. L. Grant*; Mariposa Co.: e. of Merced Falls, “grassy hillsides,” *J. T. Howell 4159*.

G. SPECULARIOIDES subsp. **candida**, subsp. nov.—Planta altior, altitudine 15–20 cm. basi ramosissima, caulibus multis, quadrangulatis, infime angulato-hirsutulis, ceteroqui glabriusculis; foliis reductis, sessilibus, glabriusculis, laminis cuneato-ovatis, aliquantum serrulato; calycis tubo solum striato-sulcatis, laciniis linearibus, integerrimis, ciliatis, 5–8 mm. longis; corollis albidis, 4–5 mm. longis, calycis lacinias aequantibus; seminibus subtrigonis, 0.8–0.9 mm. longis, nitento-rubicundis.—TYPE: *Munz 9806* (Pomona Coll. Herb. 98396) taken on “gravelly burn in chaparral,” 6 mi. n. of Santa Ysabel, San Diego Co., Calif., 19 V 1925. ISOTYPE in Univ. Calif. Herb., Berkeley. OTHER COLLS.: Riverside Co.: 10 mi. s. of Hemet, *Munz 10,807*; San Diego Co.: Cuyamaca Lake, 4750 ft., *Munz 9753*; 1 mi. s. of Morettis, 19 V 1925 *Peirson*.

This species is considered beyond under the section Discussion.

4. *G. CALYCINA* Benth. Pl. Hartw. 321, 1849, based on *Hartweg 317*, from Sacramento Valley (cf. Jepson, *Erythea* 5: 31–5, 51–6, 1897, as to Hartweg’s localities in California). Notes upon type (in Herb. Benthamianum, Kew) and comparisons with recent collections made for the author in 1935 by W. L. Jepson. This type is discussed below. *G. calycina* var. *hirsuta* Benth., l. c., based on *Hartweg 416* from same locality as type of the species and probably taken along with it. This name is a *nomen nudum* with only the implication of its nature resting upon Bentham’s choice of varietal name. The type consists of four plants differing from the species only in their markedly pubescent condition.—Plants of spreading somewhat bushy habit, 8–25 cm. high, the stem stout, strongly angled throughout, usually much branched from the base or less often only from above with spreading branches, these proximally horizontal and distally ascending or up-turned at their tips; herbage at first downy then early prevalently gray scabrous-hispidulose with abundant but scattered spreading or retrorse hairs; middle and upper cauline leaves scattered, the blades narrowly oblong or less often ovate, especially below, 8–12 (or 16) mm. long, strongly serrulate, hirsutulous, at length glabrate; flowers both axillary and terminal, large and conspicuous (for the genus), especially in a large-flowered race; calyx-tube slender-conic, clearly ribbed, 4–6 mm. long at anthesis, accrescent, glabrate, the lobes linear-subulate, acuminate or abruptly acute, 6–12 mm. long at anthesis; corolla nearly two-thirds length of calyx-lobes, cylindro-campanulate, 6–10 mm. long, bright dark blue fading whitish; capsule firm, subcoriaceous, the

calyx-lobes then 12–20 mm. long and widely outwardly spreading; seeds elliptical, lenticular, 0.8 mm. long, smooth, chestnut-brown. Representative colls.: OREGON: Jackson Co.: Wimer, 24 IV 1889, *E. W. Hammond* 252. CALIFORNIA: Mendocino Co.: Anderson Valley, 18 V 1866, *Bolander* 4797; Siskiyou Co.: Oro Fino, *Geo. D. Butler* 613; Shasta Co.: Pit R. Ferry, *H. E. Brown* 257; Redding (7 mi. from, on Alturas Hgy.), *R. F. Hoover* 2279; Tehama Co.: Stivers Rch., 25 IV 1899, *Jepson*; 2 mi. s. of Red Bluff, “low places in a grain field on a treeless plain, red clay soil,” *Heller* 12,327; Plumas Co.: Round Valley, 1866, *Bolander* 4693; Marston sta. 3500 ft., *Heller* 10,840 (good match for type of var. *hirsuta*, fide *Jepson*); Lake Co.: Lakeport, *C. F. Baker* 2956; Napa Co.: Napa R. basin, IV 1893, *Jepson*; Solano Co.: Walker Canyon, Vaca Mts., *Jepson* 14,772; Contra Costa Co.: Clayton, 16 IV 1889, *Chesnut & Drew*; Tuolumne Co.: Columbia, *Jepson* 6336; Calaveras Co.: Avery, *W. W. Eggleston* 9196; Stanislaus Co.: Woodward Reservoir n. of Oakdale, *R. F. Hoover* 1937. Intermediate coll. between *G. calycina* and *G. pulchella*: Warnerville, Stanislaus Co., Calif., *R. F. Hoover* 1037 (possibly a hybrid). Large-flowered race of *G. calycina*: Butte Co.: Richardsons Sprs., *Heller* 11,423; Berry Canyon near Clear Creek, *Heller & Brown* 5548; same loc., *Heller & Brown* 5491 (coll. in fruit, very variable among herbaria); 3 mi. n. of Chico, *R. F. Hoover* 2236; Iron Canyon, V 1896, *Austin* 286; fields near Chico, 25 IV 1897, *Austin* 1832.

This large-flowered race of *Githopsis calycina*, known only from Butte County, can be contrasted with the typical phase of the species as follows:

Typical <i>G. calycina</i>	Large-flowered race
<i>Corolla</i> scarcely showy, the lobes shorter than or equalling the calyx-lobes in anthesis.	<i>Corolla</i> showy, the lobes mostly exceeding the calyx-lobes in anthesis.

The author finds that the hirsute forms vastly outnumber the glabrate plants. Glabrous and the more usual hirsute plants often occur together in compact populations suggesting their origin from a single capsule. Bentham's variety *hirsuta* would, then, seem to be the prevalent biological phase of the species, with the glabrous nomenclatorially “typical” plants decidedly in the minority. It is pointless at this time to divide the species subspecifically upon the basis of pubescence. As for the type of var. *hirsuta* Dr. *Jepson* has recorded the pubescence as “rough, scaberulous, with short stiff spreading hairs often thickened or broadened at the base, markedly retrorse on calyx-tube, mostly spreading on calyx-segments.”¹ The stems are chiefly, though not wholly, pubescent on the angles.

¹ Memorandum in *Jepson Herb.* accompanying *Jepson* 6336, Columbia, Tuolumne Co., compared with the type.

Bentham in describing this species writes "calycis tubus. . . . post anthesin elongatus, profunde 10-striatus." Although but one flower was sufficiently mature to show the condition well, the fruiting calyx on the type shows *strong* ribs and not mere striae. This character is not confined to the type collection but the species over its whole range has a distinctly ribbed, not merely striated, calyx-tube.

The effect of microclimates upon vernal annuals is well shown by *Githopsis* species. *Githopsis calycina* as it grows in the foothills of Butte County, California, may in one small ravine be in late fruiting stage on May 8th (e.g. *Heller & Brown 5491* from Berry Canyon) while on an adjoining hillslope one may collect six days later, on May 14th, plants in early anthesis (e.g. *Heller & Brown 5548* from same loc.). To one familiar only with a steady progression of flowering periods, what Setchell has called "waves of anthesis," this sounds incoherent and baffling. Yet while this vaster phenomenon is going on over wide biotic and climatic areas this important minor effect of microclimates is operating in more limited habitats, such as a single slope of a mountainside or a small ravine.

5. *G. DIFFUSA* Gray, Proc. Am. Acad. **17**: 221. 1882, based on *Parish Bros. 830* from Cucamonga Mt., San Gabriel Mts., VI 1881. Notes upon type (in Gray Herb.) communicated by C. A. Weatherby. Isotypes (in Dudley and U. S. National herbaria) studied.—Plants of slender strict habit, the stems simple or sparingly and openly branched above, 10–20 (or 30) cm. high; herbage wholly glabrous except for slight ciliation at the base of the calyx-lobes; cauline leaves obovate, crenulate or serrulate, 4–7 mm. long, plane-margined, commonly not withered at anthesis; flowers few, scattered, borne in uppermost axils; calyx-tube linear, slightly enlarged at the summit, 4–8 mm. long, 5-nerved, not at all ribbed, glabrous, the lobes linear, thin, plane, acute, rarely with a few lateral teeth, erect; corolla subcylindrical, light purple, 3–5 mm. long, the lobes acute, about half as long as the calyx-lobes; capsule but little enlarged over the flowering calyx, 5-nerved, glabrous, the calyx-lobes then spreading but straight; seeds ovoid, 0.6–0.8 mm. long, subterete, smooth, shining, light brown.—Collections examined: CALIFORNIA. Los Angeles Co.: "near Los Angeles" [Mt. Wilson, as determined by his itinerary (Ewan mss.)], 1892, *A. Davidson* (U. C. Herb.); Mt. Wilson trail, 2500 ft., 12 VI 1892, *A. Davidson* (reported in *Erythea* **2**: 84); one-half mile below Sturdevants, San Gabriel Mts., 3500 ft., *Peirson 1208* ("not common but at this location it was abundant for a considerable distance. Growing on shaded rather moist banks," note in *Jepson Herb.*); Bear Canyon trail to summit of Mt. San Antonio, *T. Craig 412*; San Bernardino Co.: Lower San Sevaine Flats, 4700 ft., *Johnston 10 VII 1925* ("one plant at edge of runway below spring hole").

Githopsis diffusa as now known is a narrow endemic of the San Gabriel Mts. What may prove to be this species when more collections are available has been taken in the Vaca Mts. of Solano County, in the North Coast Ranges (Walker Canyon, 17 V 1892, *Jepson s. n.*). Collections of this species are rare in herbaria; the plant is delicate and growing as it does on shaded banks it is doubtless easily overlooked rather than actually absent from its localized habitats. In many of its characters *Githopsis diffusa* more closely resembles *G. specularioides* than it does its sister endemic *G. gilioides*, herein described as new.

6. *G. gilioides* Ewan, sp. nov. Planta humilis depresso-globosa altitudine 6–10 cm. basi ramosissima, caulibus subangulatis praesertim infimo striato-hirsutulis; foliis imprimis cuneato-ovatis, sessilibus, paginis ambobus saepius hirsutulis interdum glabriusculis, marginibus tenuibus nullo modo callosis; floribus sessilibus calycis tubo retrorse hirtello interdum glabriusculo laciniis acuminatis; corollis 4–5 mm. longis calycis laciniis aequantibus; seminibus ellipticis fuscis, 0.7–0.9 mm. longis, subcylindratis nullo modo angulatis.—TYPE: *Peirson 5780* (U. C. Herb. 530091) taken on chaparral “burn,” Forks of San Gabriel River, Los Angeles Co., 1750 ft., 23 IV 1925. OTHER COLLS.: San Gabriel Canyon, 1600 ft., *Munz 9436*; San Antonio Canyon, dry sunny flat, 4200 ft., *Wheeler 783* (less branching, more strict than other colls.).

Githopsis gilioides, the most leafy species of the genus, is remarkable for the exceptional branching character of the plants, giving a bushy, somewhat compact habit to the species. This leafiness might be accounted for upon ecological grounds, as representing a very luxuriant phase of *G. diffusa*, were it not for the fundamental differences in flower-characters setting this species apart from other members of the genus. Plant species occupying “burns” often show notable vigor in their vegetative growth but do not exhibit alterations in their floral morphology.¹

Like *Githopsis diffusa* this species is of interest to the plant geographer for its highly localized distribution, being confined to the San Gabriel Mts. of southern California. This mountain range, the subject of an extended botanical survey by the author to appear else-

¹ T. S. Brandege reported in *Zoe* 2: 120. 1891, *Campanula exigua* to “grow to a much greater size than usual” on a Mt. Tamalpais “burn” but apparently without morphological alteration. On the other hand plants growing on unburned areas in deep soils rich in the requisite nutrients of the particular species may assume the characteristic luxuriance of “burn” specimens. Every exceptional specimen cannot, therefore, be assigned to the effects of fires.

where, has been a center of origin for some seventeen species and subspecies of plants endemic to it.

7. *G. filicaulis* Ewan, sp. nov. Planta delicatula altitudine 10–25 cm. basi aliquantum ramosa et divaricata, caulibus paucis filiformibus elongatisque subvolubilibus angulatis striato-hirsutulis; foliis inconspicuis subsessilibus laminis ovato-oblongis marginibus serrulatis glabriusculis 1–3 mm. longis; floribus minutis sessilibus calycis tubo leviter striato glabriusculo 3–5 mm. longis, laciniis linearibus acutis; corollis minutissimis, calycis laciniis brevioribus; seminibus lineari-ellipticis, apicibus ambobus acutis, 0.6–0.9 mm. longis nitentorubicundis.—TYPE: *C. R. Orcutt* coll. (U. S. Nat. Herb. 1402913) taken at Mission Canyon, San Diego, Calif., 8 V 1884. ISOTYPE (in U. C. Herb.) studied. ADDITIONAL COLL.: MEXICO: Lower California: near Vallecito, 22 V 1886, *C. R. Orcutt*.

Githopsis filicaulis, the most slender species of the genus, follows a pattern for endemic species of many genera inhabiting San Diego County in having smaller floral parts than its relatives to the north. That is, in a given genus having several species well distributed over California, it is not uncommon to find a member showing diminutive flower-parts, often the smallest flowers of the species-group, inhabiting the extreme southern part of the state. It is sometimes a single species in a genus of perhaps half a dozen California members, such as the present genus *Githopsis*; again it may be only a subspecies or merely a well-marked race of a widely distributed species. To illustrate: *Delphinium Parryi* and *Calochortus albus* each have a small-flowered race in this region. The variety *sanguinea* of the widespread *Monardella lanceolata* represents another example of this phenomenon.

DISCUSSION

Fernald has suggested that four closely related species of the genus *Sabatia*, section *Pleienta*, have presumably all evolved from a common ancestor which once grew on the coastal plain of southeastern North America. The four species now occupy almost completely discrete but contiguous areas within the range of the ancestral species.¹ Speciation in *Githopsis* may have come about by a like fragmentation of a once widespread ancestor, conceivably resembling *Githopsis specularioides*. This prototype, then, occupied the whole of the inhabitable valleys and lower foothills of the Pacific Coast during late Tertiary time, since the whole nature of the plant—its habit, its gross morphology and habitat-preference today—lead one to conclude

¹ See map, Fig. 188, in Sinnott, *Botany: Principles and Problems*, ed. 3, 1935.